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Private-Sector Credit in Central and Eastern Europe: New (Over)Shooting Stars?

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Abstract

This paper analyzes the equilibrium level of private credit to GDP in 11 Central and Eastern European countries in order to see whether the high credit growth recently observed in some of these countries led to above equilibrium private credit-to-GDP levels. We use estimation results obtained for a panel of small open OECD economies (out-of-sample sample) to derive the equilibrium credit level for a panel of transition economies (in-sample panel). We opt for this (out-of-sample) approach because the coefficient estimates for transition economies are fairly unstable. We show that there is a large amount of uncertainty to determine the equilibrium level of private credit. Yet our results indicate that a number of countries are very close or even above the estimated equilibrium levels, whereas others are still well below the equilibrium level.

JEL: C31, C33, E44, G21

Keywords: private credit, credit growth, transition economies.

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1 Introduction

The emerging literature on credit growth in transition economies has documented that lending to the private sector has recently grown dynamically in a number of transition economies.[1] This can be attributed to a number of factors, including macroeconomic stabilization, comprehensive reforms and privatization in the financial sector, the introduction of market institutions and legal reforms. However, given the size of the recent boom in bank lending in Central and Eastern Europe (CEE) some commentators have questioned whether the growth rates recorded in these countries can be viewed as sustainable in the medium to long run.

In order to answer this question, this paper investigates the determinants of domestic credit to the private sector as a percentage of GDP in 11 CEE countries[2] as well as the equilibrium level of private credit-to-GDP ratio. We have tested our empirical specifications for a variety of panels composed of (1) transition economies, (2) developed small and large OECD countries and (3) emerging market economies from Asia and the Americas.

The use of these panels provides some interesting perspectives. First, in-sample panels give useful insights regarding the major determinants of credit-to-GDP levels in CEE. Second, as financial depth in most transition economies remains comparatively low, it might well be that private credit-to-GDP ratios have still remained below their equilibrium levels for most of the last decade. This would give rise to a bias in the econometric estimates, as credit-to-GDP ratios tend to converge toward their equilibrium levels.[3] To overcome this problem, we could use estimates obtained from panels composed of small open OECD and emerging market economies from Asia and the Americas to obtain the equilibrium credit-to-GDP ratios for 11 CEE countries.

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[1] See e.g. Cottarelli, Dell'Ariccia and Vladkova-Hollar (2003), Schadler (2005), Backé and Zumer (2005), Duenwald, Gueorguiev and Schaechter (2005), Pazarbaşýoğlu et al. (2005), Coricelli, Mucci and Revoltella (2006) and Hilbers, Otker-Robe and Pazarbaşıoğlu (2006).

[2] Countries included are Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

[3] An analogous line of reasoning is applied in the literature on equilibrium exchange rates of CEE countries (Maeso-Fernandez, Osbath and Schnatz, 2005).

The paper is structured as follows. Section 2 reviews some stylized facts regarding credit growth in the transition economies. Section 3 briefly overviews the relevant literature, sketches the issue of initial undershooting and overshooting of the credit-to-GDP ratio, and examines their consequences for econometric testing. Section 4 presents the economic specification used for the estimations and describes the dataset and the estimation techniques. Section 5 then presents and discusses the estimation results. Finally, Section 6 draws some concluding remarks.

2 Some Stylized Facts

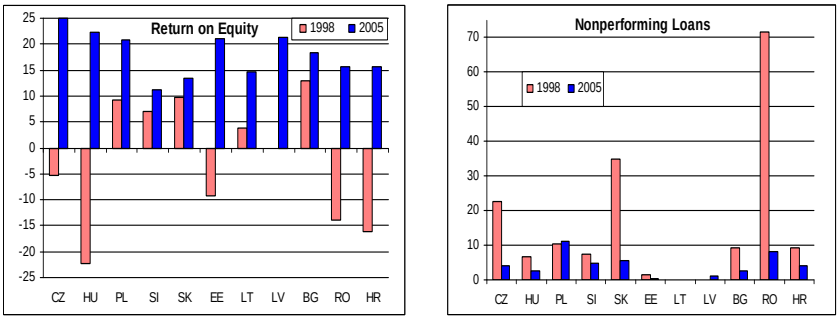
To place credit developments in transition economies into context, it is useful to recall that financial systems in these countries are bank-based – about 85% of financial sector assets are bank assets – and that capital markets (in particular corporate bond and stock market segments) are generally not very developed. This implies that bank credit is the main source of external financing in these countries, although foreign direct investment (FDI) has also been important in some countries. Banking sectors in transition economies in CEE have undergone a comprehensive transformation in the past 15 years or so, including wide-ranging reforms of their regulatory frameworks and supervisory arrangements, bank consolidation schemes and – in almost all countries – sweeping privatization of financial institutions, mainly to foreign strategic owners (mostly financial institutions based in "old" EU Member States). Consequently, the governance of banks has greatly improved, and the performance and health of these banking sectors have advanced substantially, as standard prudential indicators show.[4]

In 2005, the banking systems' capital adequacy ratios in the 11 countries ranged from 10.6% (Slovenia) to 20.3% (Romania), with an unweighted average of about 13%, well above the statutory minimum of 8% prescribed by the Basel rules. Profitability has risen considerably, as return on equity data show, and is now above the EU average (about 13%) in most countries covered in this

[4] On recent assessments of banking sector performance and strength in CEE countries see e.g. ECB (2005a, 2005b and 2006), EBRD (2005), IMF (2005a, 2005b and 2006), IMF Financial System Stability Assessments (http://www.imf.org/external/NP/fsap/fsap.asp).

study (see Chart 1). Asset quality has improved, as non-performing loan ratios have fallen (see Chart 1). Reserves and provisions now cover a considerable part of substandard assets in most of the countries under review here, as coverage ratios ranged from 60% to 100% in 2005 in most cases, with an unweighted average of about 85%.[5]

Chart 1. Return on Equity and Nonperforming Loans



Source: National central banks.

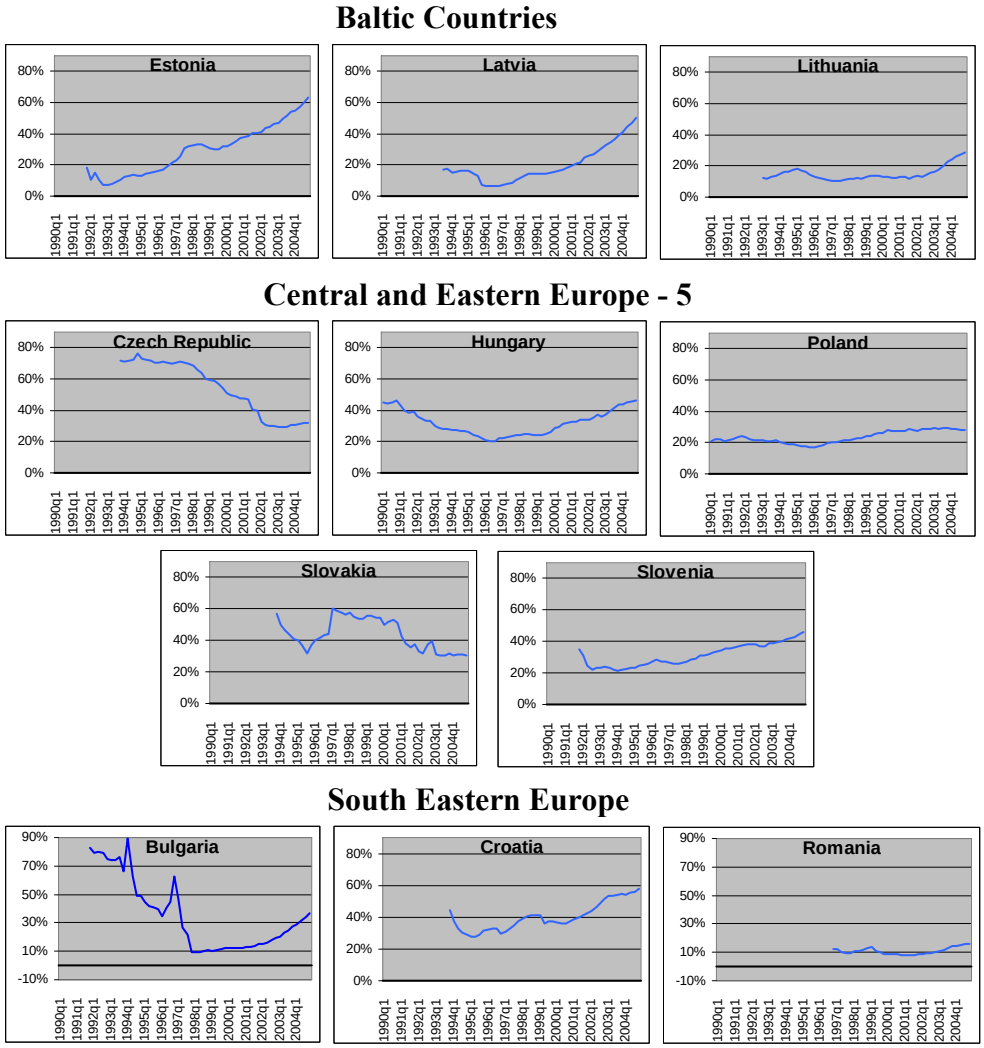
Note: Return on equity: Slovakia: value 2000 (instead of 1998); Romania: value 1999 (instead of 1998); Latvia: value 2004 (instead of 2005)

Nonperforming loans: Latvia: value 2004 (instead of 2005); no data available for Lithuania

Chart 2 gives an overview of the development of credit to the private sector in percent of GDP from the early 1990s to 2004. Several observations can be made on the basis of chart 1. Some countries, namely Estonia, Latvia, Lithuania, Poland, Romania and Slovenia, started transition with low credit-to-GDP ratios of around 20%. Estonia and Latvia then recorded a marked increase in the ratio, and the credit-to-GDP ratio also rose steadily in Slovenia from the early 1990s to 2004 although the overall increase was less pronounced than in the two aforementioned Baltic countries. Credit growth has picked up only recently in Lithuania and Romania, and for Poland, only a moderate increase can be observed during the second half of the period studied.

[5] Romania (15%) and Hungary (44%) are outliers in this respect. It should be noted, however, that a low coverage ratio is not necessarily problematic, as it can to some extent reflect the classification and composition of non-performing assets. Moreover, a high level of capitalization may provide an alternative cushion if the coverage ratio of reserves and provisions is low.

Chart 2. Bank Credit to the Private Sector as a Percentage of GDP, 1990 to 2004



Source: Authors' calculations based on data drawn from the IFS/IMF. For precise data definitions, see Section 4.2.

By contrast, the second group of countries, notably Croatia and Hungary, started transition with higher credit-to-GDP ratios than the Baltic countries. After dropping considerably to close to 20%, the ratio started to increase, reaching pretransition levels in Hungary and growing to levels well exceeding 40% in Croatia by 2004.

The third group of countries, comprising Bulgaria, the Czech Republic and Slovakia, had the

highest credit-to-GDP ratio at the beginning of the period (between 60% and 80%). For Bulgaria, this ratio came down to 10% in 1997, while expanding to close to 40% by 2004.[6] The Czech Republic and Slovakia also recorded a substantial contraction (to nearly 30% for both countries), while the ratios seem to have stabilized during the last couple of years.

The differences in initial credit-to-GDP levels can be traced largely to different approaches with respect to the financing of (credit to) enterprises under central planning across countries as well as strongly diverging inflation (price level adjustment) patterns across countries at the initial stage of transition. In turn, major temporary contractions in credit-to-GDP ratios during the transition process have mainly been due to banking consolidation measures, by which nonperforming assets were removed from banks' balance sheets. Such nonperforming assets (mostly loans) had either been inherited from the previous era of central planning or were built up in the early transition years, when banking systems were still immature, flawed by inadequate regulation, connected lending and simple lack of experience.

3 The Equilibrium Level of Private Credit

3.1 Literature Overview

Several theoretical and empirical studies have dealt with credit growth, financial deepening and lending booms. One body of literature on credit growth reviews the determinants of credit demand and credit supply. In the models on credit demand, real GDP, prices and interest rates are commonly the explanatory variables, although there is no "standard" model is widely used. On the supply side, a variety of credit channel models consider how changes in the financial positions of banks (bank lending channel) and borrowers (balance sheet channel) affect the availability of credit in an

[6] Note that the peculiar and rather fuzzy pattern of the credit-to-GDP ratio in Bulgaria shown in chart 1 is not due to data problems but, to a considerable extent, driven by exchange rate movements. The ratio rose sharply in 1994, 1996 and 1997 because of the depreciation of the domestic currency vis-à-vis the U.S. dollar, considering that a significant share of credit was denominated in foreign currency (mainly U.S. dollars). Correction of the credit ratio occurred in the post-crisis period because of the appreciation of the domestic currency and because of the write-off of nonperforming loans.

economy (see Hall, 2001, for a succinct overview). However, modeling and estimation techniques in this area are complicated due to difficulties in separating demand-side effects from supply-side effects (see e.g. Rajan 1994).

Regarding the relationship between credit and growth, there are strong empirical indications of a positive interaction between the two, usually with elasticity higher than one in the long run. This implies that credit-to-GDP levels rise as per capita GDP increases, a process which is denoted as financial deepening (see Terrones and Mendoza, 2004 for a concise overview). In addition, empirical studies have examined the direction of causality; with most results suggesting that it is financial deepening which spurs economic development (see e.g. Beck, Levine and Loayza, 2000, and Rajan and Zingales, 2001 for an overview). While the results of this literature are appealing, it is difficult to establish genuine causality, while nonlinearities in the relationship between financial development and growth as well as country heterogeneity add to the problems of empirical analysis in this area (see discussion in Favara, 2003).

The literature on lending booms has identified four main triggers: (i) real business cycles caused by technological or terms-of-trade shocks (with highly pro-cyclical output elasticity of credit demand), (ii) financial liberalization of an initially repressed financial system, (iii) capital inflows triggered by external factors, and (iv) wealth shocks originating from comprehensive structural reforms (see Gourinchas, Valdes and Landerretche (2001) for a survey). In addition, less than fully credible policies (in particular exchange rate-based stabilizations) can also play a role in spurring credit booms, by setting off an unsustainable consumption boom (see Calvo and Vegh (1999) for a review). Moreover, the financial acceleration literature, including the more recent literature on credit cycles, gives some theoretical insights into the mechanisms that drive or amplify credit expansions, which turn out to be non-sustainable and thus ultimately require a correction (Terrones and Mendoza, 2004). There is little evidence in the empirical literature that lending booms typically lead to financial crises. As Gourinchas, Valdes and Landerretche. (2001) point out, while the conditional probability of a lending boom occurring before a financial crisis may be quite high,

this does not tell us much about the converse, i.e. the conditional probability that a financial crisis will follow a lending boom.[7]

3.2 Initial Under- and Overshooting in Transition Economies

The question of whether or not credit growth in transition economies is excessive is closely related to the issue of what the equilibrium level of the stock of bank credit to the private sector as a share of GDP in those countries is. In this study, we define the equilibrium level of private credit as the level of private credit, which would be justified by the economic fundamentals. Deviations from the equilibrium level occur if changes in the private credit-to-GDP ratio cannot be explained by changes in the economic fundamentals (so-called undershooting and overshooting). Hence, our notion of equilibrium is very close to the one used for instance in the literature on equilibrium exchange rates (Behavioral Equilibrium Exchange Rate - BEER) and in other fields of the economic profession.[8]

Chart 3 demonstrate when moving from point A through B to C, the level of private credit increases as a function of the underlying fundamentals. The depicted trajectory of the increase in the credit-to-GDP ratio (credit growth) can be thought of as an equilibrium phenomenon.

However, we may also think of a situation when the observed credit-to-GDP ratio is out of tune with economic fundamentals. For example, Point A' depicts the situation when the initial credit-to-GDP ratio is higher than what the level of economic development would justify (initial overshooting), whereas Point A" shows where this ratio is lower (initial undershooting). In these cases, credit growth should differ from the equilibrium rate of growth, and this would secure the

[7] The financial accelerator literature, including the more recent literature on credit cycles, gives some theoretical insights into the mechanisms that drive or amplify credit expansions, which later on turn out to be non-sustainable and thus ultimately require a correction. Overshooting, to give just one example, may occur if bank managers follow overly loose credit policies in order to boost current bank earnings at the expense of future earnings. Moreover, as information externalities make banks' credit policies interdependent, banks coordinate and tighten credit policy in the event of an adverse shock to borrowers (Rajan, 1994).

[8] Note that our definition of equilibrium is not suitable for analyzing the connection between credit growth and external sustainability, financial stability aspects of credit growth or the optimal currency (foreign currency vs. domestic currency) or sectoral (households vs. corporate sector) composition of the credit-to-GDP ratio.

return to the equilibrium level of the credit-to-GDP ratio.[9]

Initial undershooting (Point A") may be important for transition economies, most of which started their economic transformation process with lower levels of credit-to-GDP ratios than other countries at the same level of development would have in other parts of the world. This is the heritage of central planning as under the Communist regimes the financial sector was underdeveloped. Hence, once economic transformation from central planning to market is completed, higher credit growth in the transition economies may partly reflect the correction from this initial undershooting to the equilibrium level of the credit-to-GDP ratio. This is shown in Chart 3, where the move from A" to B can be decomposed into (a) equilibrium credit growth, given by A" to B", and (b) the adjustment from initial undershooting to equilibrium (from B" to B). However, in cases of high credit growth rates, the increase in credit to GDP may be even higher than justified by the equilibrium change and the correction from the initial undershooting. The move from A" to B' on Chart 3 indicates such an overshooting, where the excessive increase in credit to GDP is given by the distance between B and B'.

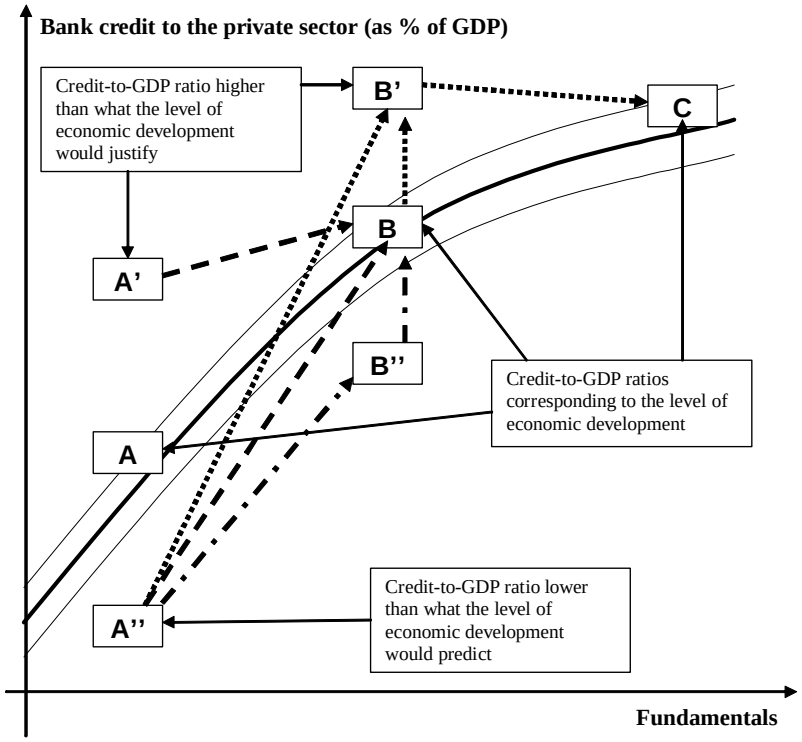
3.3 The Consequences of an Initial Under- or Overshooting

If there is initial undershooting or overshooting at the beginning of the transition process and if the adjustment toward equilibrium occurs gradually (implying persistent initial undershooting or overshooting), the use of panels that only include transition economies may lead to severely biased constant terms and coefficient estimates, as put forward in the context of equilibrium exchange rates by Maeso-Fernandez, Osbat and Schnatz (2005). When regressing the observed credit-to-GDP ratio moving from A" to B (instead of the equilibrium change from A to B) on a set of fundamentals, the slope coefficient would suffer from an obvious upward bias. By the same token, the constant term will be lower than it would be in the absence of an initial undershooting.

[9] In both cases, credit growth is expressed in terms of GDP. For example, credit growth ([C(t)-C(t-1)]/C(t-1) is higher for countries with lower credit-to-GDP levels than for countries with higher credit-to-GDP levels if both countries have similar credit-to-GDP flows. Hence, it is more appropriate to relate changes in credit to the GDP to avoid this distortion (Arpa, Reininger and Walko, 2005), as we do in this study.

This is why it is advisable to use panels including countries which do not exhibit an initial undershooting or overshooting in the credit-to-GDP ratio or to use out-of-sample panels for the analysis of the equilibrium level of the credit-to-GDP ratio of transition economies.

Chart 3. The Evolution of the Credit-to-GDP Ratio



3.4 The Empirical Literature on Transition Economies

Cottarelli, Dell'Ariccia and Vladkova-Hollar (2005) were the first to estimate a model of the long-term relationship between the private sector credit/GDP ratio and a set of variables (see table 1) for a panel of non-transition economies. Subsequently, they produce out-of-sample estimates for private sector credit/GDP ratios of 15 CEE countries. As actual private sector credit-to-GDP levels were considerably lower in 2002 than the authors' estimates of the expected long-term credit/GDP ratios they conclude that private-sector bank credit levels in that year were not inconsistent with the structural characteristics of the economies under examination.

We are aware of two other recent studies, which also investigate the equilibrium level of private credit and the possible "excessiveness" of credit growth in transition economies. Boissay, Calvo-Gonzalez and Kozluk (2006) first estimate time series models including GDP-per-capita and real interest rates for a number of established market economies for periods with stable credit-to-GDP ratios. They then compare the average of the credit growth rates for transition economies obtained using the error correction specifications estimated for the developed countries with the observed credit growth in the transition economies. They also estimate time series models for transition economies, which include the real interest rate, a quadratic trend and a dummy aimed at capturing changes in credit growth after 2001. Their results indicate excessive credit growth in the three Baltic States and in Bulgaria and to a lesser extent also in Hungary and Croatia. At the same time, credit growth in Romania and Slovenia seems to be non-excessive.[10]

The study by Kiss, Nagy and Vonnák (2006) estimates a dynamic panel (Pooled Mean Group Estimator) model including GDP-per-capita, real interest rate and inflation of 11 euro area countries (excluding Luxembourg) to generate out-of-sample estimates for private sector credit-to-GDP ratios of the three Baltic countries and of the CEE-5 (Czech Republic, Hungary, Poland, Slovakia and Slovenia). They find that only Estonia and Latvia may have come close recently to equilibrium while the other countries have credit-to-GDP ratios below the estimated equilibrium levels. Besides being above the estimated equilibrium credit level, they define two other criteria which may indicate a credit boom: (a) if the observed credit growth exceeds the one implied by the long-run equilibrium relationship and (b) if the observed growth rate is higher than the speed of adjustment to equilibrium in the error-correction model. Overall, they find that the risk of a credit boom is high

[10] Two observations come to mind with regard to this paper. First, the quadratic trend may capture missing variables from their model (which indeed only contains real interest rates) and explosive trends due to credit boom or to adjustment from initial undershooting of credit levels. It is in fact surprising to see that a sizeable number of countries have excessive credit growth given that the quadratic trend has a very good fit thus leaving very little unexplained variation in the credit series. Second, the authors use Euribor for their only macroeconomic variable, the real interest rate. This may be problematic because some foreign currency denominated loans are linked to other currencies than the euro for instance in Hungary but also because Euribor neglects the country risk and default risk at the micro level.

in both Estonia and Latvia according to these criteria, whereas Hungary, Lithuania and Slovenia might be in the danger zone because the observed growth rates are higher than the one derived from the long-run equilibrium relationship. In addition, they argue that possible credit booms are mainly due to credit expansion to households and not to the nonfinancial corporate sector.[11]

We contribute to this literature by expanding the list of countries (11 transition, OECD and emerging market economies), the list of explanatory variables, by constructing carefully several possible benchmark country groups which share common characteristics with the transition economies (emerging markets, small emerging markets, small and open OECD countries) and by performing extensive sensitivity analysis of the estimation results.

4 Economic and Econometric Specifications

4.1 The Empirical Model

Most studies investigating credit growth employ a simple set of explanatory variables (see Table 1), which usually includes GDP per capita or real GDP, some kind of (real or nominal) interest rate and the inflation rate (Calza et al., 2001, 2003; Brzoza-Brzezina, 2005; Boissay, Calvo-Gonzalez and Kozluk, 2006 and Kiss, Nagy and Vonnák, 2006). Hofmann (2001) extends this list by house prices, a very important variable, because a rise in house prices is usually accompanied by an increase in credit to the private sector.

Cottarelli et al. (2005) use indicators capturing factors that drive the private credit-to-GDP ratio. These variables describe the degree of financial liberalization, the quality and implementation of accounting standards, entry restrictions to the banking sector and the origin of the legal system. Finally, they use a measure of public debt aimed at analyzing possible crowding-out (or crowding-in) effects.

[11] It may be noted that the two additional criteria used by the authors have some drawbacks. First, the observed growth rates may be in excess of the one derived from the long-run equilibrium relationship because of the adjustment from initial undershooting. Second, the speed of adjustment to equilibrium differs if the actual observations are below or above the estimated equilibrium.

Table 1. Overview of Papers Analyzing the Determinants of Credit Growth

Authors	Dependent variable	Explanatory variables
Calza et al. (2001)	Real loans	GDP per capita in PPS, short-term and long-term real interest rates
Hofmann (2001)	Real loans	Real GDP, real interest rate, housing prices
Calza et al. (2003)	Real loans	Real GDP growth, nominal lending rate, inflation rate
Brzoza-Brzezina (2005)	Real loans	Real GDP growth, real interest rate
Cottarelli et al. (2005)	Credit to the private sector (%GDP)	GDP per capita in PPS, inflation rate, financial liberalisation index, accounting standards, entry restrictions to the banking sector, German origin of legal system, public debt
Boissay et al. (2006)	Credit to the private sector (%GDP)	GDP per capita, real interest rate (Euribor), quadratic trend
Kiss et al. (2006)	Credit to the private sector (%GDP)	GDP per capita, real interest rate inflation rate

Note: GDP per capita in PPS (purchasing power standards) is obtained by converting GDP per capita figures using the nominal exchange rate given by the domestic and foreign price levels (P/P*).

The economic specification which we estimate for the private credit-to-GDP ratio relies on explanatory variables used in previous studies, but also extends them. We consider the following variables:

1.) GDP per capita in terms of purchasing power standards (PPS) ($CAPITA$). An increase in per capita GDP is expected to result in an increase in credit to the private sector. Alternatively, we also use real GDP ($gdpr$) and industrial production (ip) to check for the robustness of the GDP per capita variable and to see to what extent these variables, which are used interchangeably in the literature, are substitutes.

2.) Bank credit to the government sector as a percentage of GDP (C^G). As this variable captures possible crowding-out effects, any increase (decrease) in bank credit to the government sector is thought to give rise to a decrease (increase) in bank credit to the private sector. It should be noted that bank credit to the government measures crowding out better than public debt as employed in Cottarelli et al. (2005), because public debt also includes loans taken out abroad and

because public entities may well finance themselves on the securities markets. Moreover, public debt is subject to valuation and stock-flow adjustments.

3.) Short-term and long-term nominal lending interest rates (i). Lower interest rates should promote credit to the private sector, implying a negative sign for this variable. Calza et al. (2001) use both short-term and long-term interest rates, arguing that whether either rates play a more important role depends on the respective share of loans with fixed interest rates and variable interest rates. Because the nominal lending interest rates used in the paper show a high correlation with short-term interest rates (three-month Treasury bills and money market rates), short-term interest rates are used as a robustness check rather than as an additional variable.

4.) Inflation (p). High inflation is thought to be associated with a drop in bank credit to the private sector. Inflation is measured both in terms of the producer price index (PPI) and the consumer price index (CPI).

5.) House prices (p^{house}). There are a number of reasons why changes in housing prices might lead to changes in credit demand. First, increases in housing prices result in a rise in the total amount which has to be spent to purchase a given residential or commercial property. This is subsequently reflected in an increase in demand for credit through which the higher purchasing price can be fully or partly financed. This means that an increase in housing prices may generate more credit to the private sector. Second, rising housing prices may generate a rise in credit demand of homeowners as higher housing prices increase lifetime wealth according to Modigliani's lifecycle theory, which in turn leads to consumption smoothing by means of more borrowing. By contrast, higher housing prices are usually connected to higher rents, which decrease borrowing of renters (Hofmann, 2001). Third, credit demand may be affected by housing prices because Tobin's q theory is also applicable to the housing market. For example, a higher-than-unity q implies market value above replacement cost, and this promotes construction production, which is reflected in higher demand for loans. Changes in commercial and residential property prices also have an influence on credit supply. According to the broad lending channel, net wealth, serving as

collateral for credit, determine the capacity of firms and household to borrow externally. Put differently, higher housing prices resulting in rising net wealth increase the amount of credit provided by banks. Overall, both credit supply and demand bear a positive relationship to housing prices from a theoretical viewpoint.

However, a fundamental problem arising here is whether price increases in the real estate market are driven by fundamental factors or whether they reflect a bubble. If price developments in the real estate market mirror changes in fundamentals, such as the quality of housing or adjustments to the underlying fundamentals, the ensuing rise in the stock of credit can be viewed as an equilibrium phenomenon. In contrast, in the event that high credit growth is due to the development of a housing price bubble due to speculation, the accompanying credit growth is a disequilibrium phenomenon from the point of view of long-term credit stock.

6.) The degree of liberalization of the financial sector, in particular that of the banking sector. A higher degree of financial liberalization makes it easier for banks to fund credit supply. Because the financial liberalization indices ($finlib$) used in Abiad and Mody (2003) and Cottarelli et al. (2005) only partially match our country and time coverage, we use in addition the spread between lending and deposit rates to capture financial liberalization. A decrease in the spread can be an indication of financial liberalization in particular if it reflects more intensive competition among banks and also between banks and other financial intermediaries. It should be noted, however, that the spread variables could also capture other factors than financial liberalization.[12] With this caveat and limitation in mind, spread variables are still the most appropriate variables to capture financial liberalization that are available for all the countries in the different panels covered in this study.

7.) Public and private credit registries (reg). The existence of credit registries diminishes problems related to asymmetric information and the probability of credit fraud. This in turn leads

[12] Note e.g. that the recent decline in the absolute level of spreads may be partly due to record low global interest rates.

to an increase in the supply of bank credit, all things being equal.[13][14]

For some of the variables, it is notoriously difficult to separate whether they influence the demand for or the supply of credit. For instance, GDP per capita and the interest rate variables could affect both credit demand and supply. These problems were tackled in the literature on the credit channel by the use of bank- and firm-level data.[15] However, given that we are interested in aggregated macroeconomic variables, these identification issues are beyond the scope of this paper.

Our baseline specification includes per capita GDP, bank credit to the public sector, nominal lending rates, inflation rates and financial liberalization based on the spread:

$$C^P = f(\overset{+}{CAPITA}, \overset{-}{C^G}, \overset{-}{i^{lending}}, \overset{-}{p^{PPI}}, \overset{-}{spread}) \tag{1}$$

where C^P is bank credit to the private sector expressed as a share of GDP. In addition, it is worthwhile checking whether the robustness of the variables included in equation (1) is affected by the use of alternative measures often used in the literature (e.g. replacing GDP per capita by real GDP growth and real industrial production, or long-term lending rates by short-term lending rates, and the PPI by the CPI). These alternative variables are subsequently introduced one by one in the baseline specification, which yields five additional equations.

$$C^P = f(\overset{+}{ip}, \overset{-}{C^G}, \overset{-}{i^{lending}}, \overset{-}{p^{PPI}}, \overset{-}{spread}) \tag{2}$$

$$C^P = f(\overset{+}{gdpr}, \overset{-}{C^G}, \overset{-}{i^{lending}}, \overset{-}{p^{PPI}}, \overset{-}{spread}) \tag{3}$$

[13] In contrast to Cottarelli et al. (2005), for econometric reasons, we do not include a variable that captures the tradition of legal systems of countries, which can affect financial development. The mean group estimator (MGE) estimation methods in section 5 do not allow the use of dummy variables that take a value of zero throughout the entire period.

[14] We are aware of the fact that the registry variable may not capture how credit contracts are enforced in courts. However, even though an easier seizure of collateral by banks may spark credit to households and small firms, such growth will probably be reflected in a one-off spike in growth rates.

[15] For an overview, see e.g. Kierzenkowski (2004).

$$C^P = f(\overset{+}{CAPITA}, \overset{-}{C^G}, \overset{-}{i^{short-term}}, \overset{-}{p^{PPI}}, \overset{-}{spread}) \tag{4}$$

$$C^P = f(\overset{+}{CAPITA}, \overset{-}{C^G}, \overset{-}{i^{lending}}, \overset{-}{p^{CPI}}, \overset{-}{spread}) \tag{5}$$

$$C^P = f(\overset{+}{CAPITA}, \overset{-}{C^G}, \overset{-}{i^{lending}}, \overset{-}{p^{PPI}}, \overset{+}{finlib}) \tag{6}$$

The sensitivity check to the alternative specification is then followed by the use of the registry variable and by the inclusion of house prices:

$$C^P = f(\overset{+}{CAPITA}, \overset{-}{C^G}, \overset{-}{i^{lending}}, \overset{-}{p^{PPI}}, \overset{-}{spread}, \overset{+}{reg}) \tag{7}$$

$$C^P = f(\overset{+}{CAPITA}, \overset{-}{C^G}, \overset{-}{i^{lending}}, \overset{-}{p^{PPI}}, \overset{-}{spread}, \overset{+}{p^{house}}) \tag{8}$$

4.2 Estimation Methods

The first step is to check whether our series are stationary in levels. Four panel unit root tests are applied: the Levin, Lin and Chu (2002), the Breitung (2000), the Hadri (2000) and the Im-Pesaran-Shin (2003) tests. The first three assume common unit roots across panel members, while the Im-Pesaran-Shin test allows for cross-country heterogeneity. A further difference is that the Hadri test tests the null of no unit root against the alternative of a unit root, whereas the remaining tests take the null of a unit root against the alternative of no unit root.

If the series turn out to be nonstationary in levels but stationary in first differences, the coefficients of the long-term relationships for the relationships shown in equations (1) to (9) are derived using three alternative estimation techniques: a.) fixed-effect ordinary least squares (FE_OLS); b.) panel dynamic OLS estimates (DOLS) and c.) the mean group estimator (MGE) proposed by Pesaran, Shin and Smith (1999).

The panel dynamic OLS, which is the mean group of individual DOLS estimates, accounts for the endogeneity of the regressors and serial correlation in the residuals in the simple OLS setting by incorporating leads and lags of the regressors in first differences. The panel DOLS can be written for panel member as follows:

$$Y_{i.t} = \beta_0 + \sum_{h=1}^{n} \beta_{i,h} \cdot X_{i,t} + \sum_{h=1}^{n} \sum_{j=-k_{i,1}}^{k_{i,2}} \gamma_{i,h,,j} \cdot \Delta X_{i,h,t-j} + \varepsilon_{i,t} \tag{9}$$

where $k_{i,1}$ and $k_{i,2}$ denote respectively leads and lags and the cointegrating vector $\beta\prime$ contains the long-term coefficients of the explanatory variables (with $h = 1, .., n$) for each panel member i.

The mean group estimator (MGE) is based on the error correction form of the ARDL model, which is given for panel member i as shown in equation (10) where the dependent variable in first differences is regressed on the lagged values of the dependent and independent variables in levels and first differences:

$$\Delta Y_{i,t} = \alpha_i + \rho_i(Y_{i,t-1} + \sum_{h=1}^{n} \beta_{i,h} X_{i,t-1}) + \sum_{j=1}^{l_{i,1}} \eta_{i,j} \Delta Y_{i,t-j} + \sum_{h=1}^{n} \sum_{j=0}^{l_{i,2}} \gamma_{i,h,j} \cdot \Delta X_{i,h,t-j} + \varepsilon_{i,t} \tag{10}$$

where $l_{i,1}$ and $l_{i,2}$ are the maximum lags. The long-term coefficients (β') are obtained by normalizing vector δ' on ρ.

Finally, we use the error correction term (ρ) obtained from the error-correction specification of the mean group estimator as tests for cointegration. A negative and statistically significant error correction term is taken as evidence for the presence of cointegration.

5 Results

5.1 Estimation Results

The estimations are carried out for quarterly data covering 43 countries, which are grouped into three main panels: (a) developed OECD countries, (b) emerging markets from Asia and the Amer-

icas[16] and (c) CEE transition economies. The OECD panel is further split into two subpanels: (a) small OECD countries (excluding transition economies that have joined the OECD)[17], and (b) large OECD countries.[18] The CEE panel consists of 11 transition economies and is also subdivided into three presumably more homogeneous groups: (a) the Baltic countries (B-3): Estonia (EE), Latvia (LV) and Lithuania (LT), (b) the CEE-5: the Czech Republic (CZ), Hungary (HU), Poland (PL), Slovakia (SK) and Slovenia (SI), and (c) Southeastern Europe (SEE-3): Bulgaria (BG), Croatia (HR) and Romania (RO). The sample begins between 1975 and 1980 for the OECD countries, between 1980 and 1993 for the emerging market economies, and between 1990 and 1996 for the transition economies; it ends in 2004.[19]

Panel unit root tests are employed for level data and for first-differenced data. While the test results show that most of the series are I(1) processes, in some cases, the tests yield conflicting results for level data. However, since the tests do not indicate unambiguously in any case that the series are stationary in level, we conclude that they are I(1).[20]

When analyzing possible long-term relationships between the private credit-to-GDP ratio on the one hand and the explanatory variables on the other, one has to make sure that the variables are cointegrated. As explained earlier, the error correction terms (ρ) issued from the estimated error correction form of the MGE are used for this purpose. The variables are connected via a cointegrating vector in the event that the error correction term is statistically significant and has a negative sign. According to the results shown in Table 2 below, most of the error correction terms fulfill this double criterion. A notable exception is the panel composed of the three Baltic countries,

16 Argentina (AR), Brazil (BR), Chile (CL), India (IN), Indonesia (ID), Israel (IL), Mexico (MX), Peru (PE), the Philippines (PH), South Africa (ZA), South Korea (KR), Thailand (TH). Although South Korea and Mexico are OECD countries, they can be viewed as catching-up emerging market economies for most of the period investigated in this paper.

17 Austria (AT), Australia (AU), Belgium (BE), Canada (CA), Denmark (DK), Finland (FI), Greece (GR), Ireland (IE), the Netherlands (NL), New Zealand (NZ), Norway (NO), Portugal (PT), Spain (ES) and Sweden (SE).

18 Germany (DE), France (FR), Italy (IT), Japan (JP), the United Kingdom (UK) and the United States (US).

19 The dataset is unbalanced, as the length of the individual data series depends largely on data availability. All data are transformed into logs. See Appendix A for a detailed description of the source and the time span for variables.

20 These results are not reported in the paper but are available from the authors upon request.

as there seems to be only one cointegration relationship out of the eight tested equations.

Table 2 Error Correction Terms (ρ) from the Mean Group Estimator Estimations, Equation 1 to Equation 7

	Large OECD	Small OECD	EM	CEE-11	CEE-5	B-3	SEE
Eq.1	-0.094***	-0.063***	-0.132***	-0.281***	-0.225***	-0.103	-0.551***
Eq.2	-0.088***	-0.052***	-0.135***	-0.174***	-0.188***	-0.052	-0.273***
Eq.3	-0.092***	-0.055***	-0.202***	-0.188***	-0.183***	-0.135**	-0.248***
Eq.4	-0.097***	-0.069***	-0.189***	-0.226***	-0.136***	-0.049	-0.553***
Eq.5	-0.097***	-0.057***	-0.215***	-0.198***	-0.207***	-0.066	-0.315***
Eq.6	-0.160***	-0.049**	-0.211***	-0.233***	-0.269***	-0.120	-0.285**
Eq.7	-0.980***	-0.003**	-0.134***	-0.227***	-0.231***	-0.033	-0.414**

Note: *, ** and *** indicate statistical significance at the 10%, 5% and 1% significance levels, respectively.

EM is the panel including emerging market economies.

We can now turn to the coefficient estimates, which are displayed in Table 3 and in the Appendix C. GDP per capita enters the long-run relationship with the expected positive sign for the OECD and the emerging market panels. This result is particularly robust for small OECD and emerging market economies, with the size of the coefficient usually lying somewhere between 0.4 and 1.0 for most of the alternative specifications. However, less robustness is found for the transition countries. This holds especially true for the CEE-5, for which GDP per capita turns out to be insignificant both in the baseline and in alternative specifications. Although cointegration could not be firmly established for the Baltic countries, it is worth mentioning that GDP per capita is usually statistically significant for this group as well as for the SEE-3. The fact that the coefficients' size largely exceeds unity reflects the upward bias due to quick adjustment toward equilibrium. The results furthermore indicate that the bias is substantially larger for the Baltic countries than for the SEE-3.

With regard to credit to the public sector, the estimations provide us with some interesting insights, as an increase (decrease) in credit to the public sector is found to cause a decline (rise) in private credit. This result is very robust for emerging market economies and for the CEE-5,

as the coefficient estimates are almost always negative and statistically significant across different specifications. This lends support to the crowding-out/crowding-in hypothesis in these countries. Some empirical support for this hypothesis can be also established for the advanced OECD and for emerging market economies. By contrast, the estimated coefficients are either not significant or have a positive sign for the Baltic countries and for the SEE-3. This finding potentially mirrors the very low levels of public indebtedness of the three Baltic countries.

Let us now take a closer look at the nominal interest rate and at the inflation rate. In accordance with the results shown in Table 3 and in the Appendix C, there is reasonably robust empirical support for nominal lending rates being negatively linked to private credit in the CEE-5 as well as in emerging markets and small OECD countries. In contrast, the finding for the Baltic States and the SEE-3 is that interest rates mostly have a positive sign if they turn out to be statistically significant. Note that these results are not really affected by the use of lending rates or short-term interest rates.

For emerging economies from Asia and the Americas, particularly strong negative relationships are detected between the rate of inflation and private credit. Although less stable across different specifications and estimation methods, this negative relationship between inflation and credit is also supported by the data for the CEE-5 and for small OECD economies. By contrast, no systematic pattern could be revealed for the Baltic and Southeastern European countries.

An increase in financial liberalization, measured by a decline in spread, has the expected positive impact on private credit in small OECD economies and in the CEE-5, and also to some extent in the other transition economies. By contrast, the results for the financial liberalization index are less robust. Although the financial liberalization index is positively associated with private credit in OECD and emerging economies, it has an unexpected negative sign for all transition economies. An explanation for this may be the delay with which financial liberalization measured by this index is transmitted to private credit, whereas the spread variable captures the effective result of financial liberalization. The same mismatch between OECD and transition economies can be seen

for private and public credit registries. While changes in credit registries produce the expected effect on private credit in OECD countries, the estimation results show the opposite happening in the transition economies.

Table 3. Estimation Results – Baseline Specification

$$Vector = X\beta'$$

$$C^P = f(CAPITA, C^G, i^{lending}, p^{PPI}, spread); \beta' = [1, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5]$$

expected signs: $[1, +, -, -, -, -]$

	β_1	β_2	β_3	β_4	β_5
Large OECD					
FE_OLS	0.422***	-0.198***	-0.028	-0.394*	-0.050***
DOLS	0.391***	-0.034***	0.120***	0.241	0.171***
MGE	0.040	0.118	-0.016	-2.611**	0.207*
Small OECD					
FE_OLS	**0.480*** **	**-0.170*** **	**-0.068*** **	**-0.178**	**-0.037*** **
DOLS	0.540***	-0.065***	-0.082	0.678***	-0.143***
MGE	0.643***	0.057	-0.171	-1.272	0.281
Emerging market economies					
FE_OLS	0.492***	-0.120***	0.136***	-0.263***	0.069**
DOLS	0.715***	-0.064***	0.187***	-0.436***	-0.001
MGE	0.583***	-0.386***	0.454	-0.492***	-1.172
CEE-11					
FE_OLS	1.648***	0.053**	0.297***	-0.046	-0.640***
DOLS	0.981***	-0.169***	0.125	-0.105	-0.382***
MGE	2.043	-0.114	-0.027***	-0.263	-0.907**
CEE-5					
FE_OLS	0.169	-0.276***	-0.031	-1.179***	-0.407***
DOLS	0.375***	-0.308***	-0.046	1.062***	-0.109*
MGE	-1.076	-0.222***	-0.057***	1.501	-0.985**
B-3					
FE_OLS	2.554***	0.024	0.369***	0.396*	-0.458***
DOLS	2.227***	-0.121	0.083**	-1.676***	-0.481***
MGE	4.045	0.313	-0.124***	-2.852	-1.466
SEE					
FE_OLS	2.049***	0.455***	0.218***	-0.102**	-0.366***
DOLS	0.745***	0.013	-0.298	-0.479	-0.737***
MGE	1.654***	0.264	0.120	-0.616**	0.217

Note: *, ** and *** indicate statistical significance at the 10%, 5% and 1% significance levels, respectively. M is the panel including emerging market economies.

Because data on house prices are available only for developed OECD countries and for four transition economies (the Czech Republic, Estonia, Hungary and Lithuania), the estimations are

performed only for large and small OECD and transition economies. In addition, we constructed a panel including countries exhibiting large and persistent increases in house prices over the late 1990s, possibly indicating the build-up of a real estate bubble (Canada, Spain, France, the UK and the USA.). The results are not particularly robust for the small and large OECD economies, as the coefficient on house prices changes sign across different estimation methods (Table 4). For transition economies, even though the results are somewhat more encouraging, as the coefficient is always positively signed if it is found to be statistically significant, the estimated equations seem to be rather fragile in general.

Table 4. Estimation Results – Equation 8; Housing Prices

$$Vector = X\beta'$$

$$C^P = f(CAPITA, C^G, i^{lending}, p^{PPI}, spread, p^{housing}); \beta' = [1, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6]$$

expected signs: $[1, +, -, -, -, -, +]$

	ρ	β_1	β_2	β_3	β_4	β_5	β_6
Small OECD economies							
FE_OLS		0.611***	-0.166***	-0.098***	-0.125	-0.010	-0.062**
DOLS		0.286***	-0.064	-0.043	0.086	-0.081	0.399***
MGE	-0.207***	0.033	0.203***	-0.277**	-0.548	-0.080	0.587***
Large OECD countries							
FE_OLS		0.078*	-0.209***	-0.022	-0.855***	0.007	0.290***
DOLS		0.395***	-0.079***	-0.041*	-0.345	-0.040	-0.161**
MGE	-0.181***	-0.360	-0.049	-0.097*	-2.397***	0.139	0.544**
OECD economies with high growth rates in housing prices							
FE_OLS		0.111*	-0.160***	-0.066**	-0.787***	-0.025	0.336***
DOLS		0.334***	-0.171***	-0.043**	-0.412	0.022	0.040*
MGE	-0.176***	-0.838	-0.146***	-0.235**	-2.404**	0.432*	0.745**
CEE-4							
FE_OLS		0.316	-0.429***	0.032	-0.603***	-0.096	0.541***
DOLS		0.010***	-0.042***	0.050	-0.563**	0.002	-0.018
MGE	-0.125***	-0.651	-0.136***	-0.599***	0.080	-0.359	0.561**

Note: ρ is the error correction term. *, ** and *** indicate statistical significance at the 10%, 5% and 1% significance levels, respectively.

Now, if we look at the group of countries with large increases in house prices, it turns out that house prices are positively correlated in a robust fashion with private credit, and that the other

coefficient estimates are also in line with our earlier findings. However, the fact that the inclusion of house prices yields robust results only if large increases have taken place on the property markets might suggest that house prices mostly matter for private credit in the event of a possible housing market bubble.

5.2 Deviations from the Estimated Equilibrium Levels

We now turn to the comparison of the fitted values from the panel estimations for the transition economies to the observed values for the transition economies. This exercise makes it possible to see how far away the observed private credit-to-GDP ratio is from the estimated long-term value. As both the estimated long-run coefficients and the constant terms might be biased because of the possibility of a large initial undershooting followed by a steady adjustment toward equilibrium in transition economies, which is partly confirmed in Table 3, we are cautious about the use of in-sample panel estimates, i.e. about using the coefficient estimates obtained for the transition panels. However, more importantly, it is the lack of robustness of the coefficient estimates for the transition economies that prevents us from relying on the in-sample panel estimations. As Tables 3 and 4 and in the Appendix C show, there is no single equation for transition economies in which all coefficients are statistically significant and have the expected sign.[21]

To overcome this problem, we could apply the out-of sample analysis, using two groups of countries, namely emerging market economies and OECD countries. Emerging market economies might be expected to provide a natural benchmark for CEE economies. However, the fact that some of the coefficient estimates for this panel are not significant or, importantly, have the wrong sign these countries cannot be used as a benchmark. Therefore, we have experimented with a smaller panel including only small emerging markets (Chile, Israel, Peru and South Africa) which could

[21] Note that the analogy with the literature on equilibrium exchange rates in transition economies ends here, given that it is possible to establish robust relationships between the real exchange rate and its most important fundamentals, such as for instance productivity (see e.g. Égert, Halpern and MacDonald, 2006).

constitute a more meaningful benchmark, given the comparability of size and GDP per capita. Yet the coefficient estimates (not reported here) do not improve as the coefficients on credit to the government, the interest rate and the spread variable are either insignificant or have the wrong sign.

As a result, we are left with the OECD panels. The baseline specification estimated by means of fixed effect OLS for small open OECD economies[22] appears to be best suited, as this is the only equation where all coefficients bear the right sign and all but one are statistically significant (marked in green in Table 3).[23]

When engaging in an out-of-sample exercise, i.e. using the coefficient estimates obtained for the small open OECD panel to derive the fitted value for transition economies, the underlying assumption is that in the long run there is parameter homogeneity between the small developed OECD panel and the transition countries. One might reasonably assume that in the long run (after adjustment toward equilibrium is completed) the behavior of transition economies will be similar to the present behavior of small OECD countries. Even though this homogeneity is fulfilled between the two samples, the estimated long-run values of the private credit-to-GDP ratio and the underlying deviation from equilibrium should be interpreted from a long-run perspective.

Given that no country-specific constant terms are available for the transition economies, the next intricate issue is how constant terms should be applied to derive the fitted values.[24] Our safest bet

[22] Small OECD countries appear to be a reasonably useful benchmark, at least with respect to longer-term equilibrium levels. It should be noted that CEE countries have undergone a substantial convergence to small OECD countries in structural and institutional terms. As a consequence, four of these countries - the Czech Republic, Hungary, Poland and Slovakia - joined the OECD in the second half of the 1990s. Likewise, the EBRD transition indicators (see EBRD 2005), the standard reference point for gauging progress with the structural and institutional change in CEE countries, show that the countries under review in this study, in particular the Central European and Baltic countries, plus Croatia, have made substantial progress towards fully-fledged market economies already in the second half of the 1990s, while gradually advancing further in more recent years.

[23] Given that this relationship may have undergone some changes over time, we carried out estimations for the following subperiods: 1980-2004; 1985-2004 and 1990-2004. The coefficients do not change much both in terms of size and significance with the exception of the spread variable which becomes insignificant for 1985-2004 and for 1990-2004. Therefore, the estimation obtained for the whole period seems reasonably stable and thus suitable for proceeding further with the analysis. We also carried out estimations for a panel composed of catching-up EU countries (Greece, Portugal and Spain). However, the results (not reported here) appear to be not very robust.

[24] Note that Cottarelli et al. (2005), the first paper which derives the equilibrium level of private credit for transition economies, does not address the issue of the constant terms.

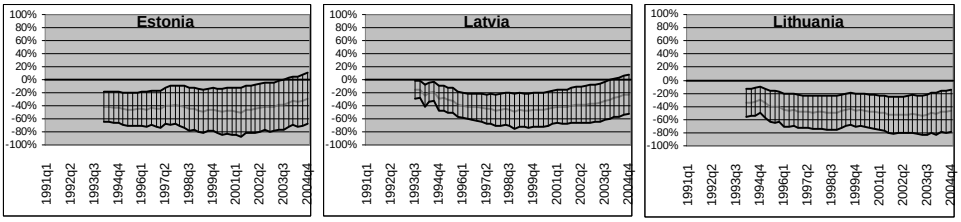
is to use the largest and the smallest constant terms (as well as the median constant term) obtained on the basis of the small OECD panel, which gives us the whole spectrum of possible estimated values for private credit.[25]

The derived range of deviation is plotted on Chart 4. The error margin is, however, rather large. Consequently, if one considers midpoints, Croatia is now the only country which might have reached equilibrium by 2004. When looking at whole ranges, other countries, namely Bulgaria, Estonia, Hungary, Latvia and Slovenia, might have already reached equilibrium as well, while the mass of the estimated deviation was still located mostly on the undershooting side in 2004. At the same time, the upper edges of the estimated band come close to equilibrium for Hungary, Bulgaria, Poland and Slovenia. Moreover, it turns out that the initial overshooting might not have been that large for the Czech Republic and Slovakia, after all. Finally, it is interesting to see that the initial undershooting remains relatively stable for Lithuania, Poland and Romania throughout the period.

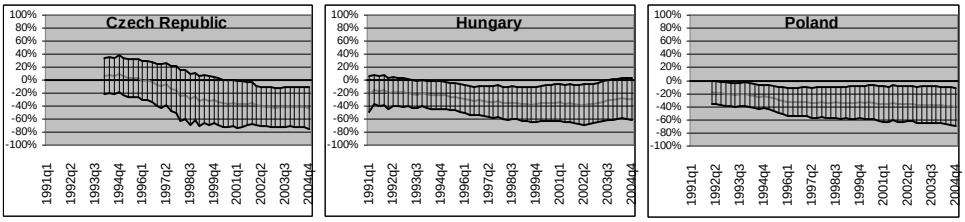
[25] Another reason for selecting the baseline specification is that the variables included are all expressed in levels, which ensures that the constant terms derived on this basis have a cross-sectional meaning. For instance, the constants would not have any cross-sectional meaning if indices with a base year were used (e.g. for industrial production or house prices).

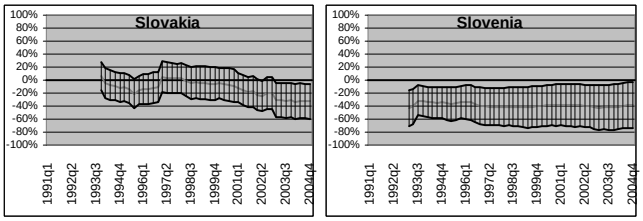
Chart 4. Deviations from Long-Run Equilibrium Credit-to-GDP, 1990 to 2004

Baltic Countries

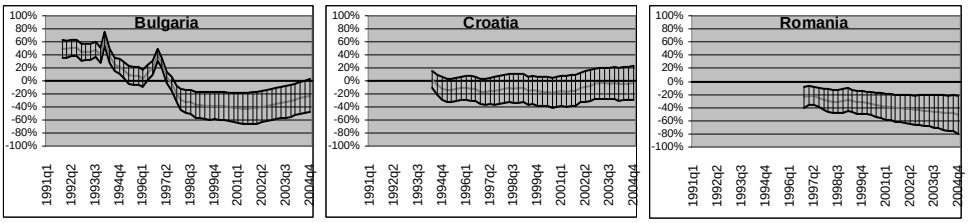


Central and Eastern Europe - 5





South Eastern Europe

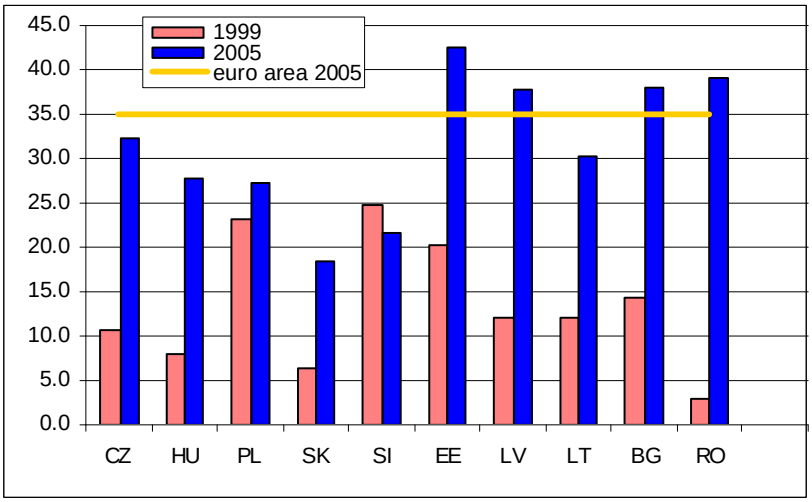


Note: negative values indicate that the observed private credit to GDP ratio is lower than what a particular country's GDP per capita would predict ("undervaluation")

Conversely, positive figures show an "overvaluation" of the private credit to GDP ratio.

One explanation for the initial undershooting observed for the countries under study is the low share of credit to households in total domestic credit. Chart 5 hereafter shows the importance of credit to households was substantially lower in transition economies than in the euro area in 1999. Nevertheless, a relative increase in credit to households can be observed over the last 7 years or so, in particular in countries where an adjustment towards equilibrium is shown on chart 4.

Chart 5. Share of Credit to Households in Total Domestic Credit



Source: National central banks.

6 Conclusion

In this paper, we have analyzed the equilibrium level of private credit to GDP in 11 transition economies from CEE on the basis of a number of dynamic panels containing quarterly data for transition economies, developed OECD economies and emerging markets, and relying on a framework including both factors that capture the demand for and the supply of private credit.

Credit to the public sector (crowding out/crowding in), nominal interest rates, the inflation rate and the spread between lending and deposit rates aimed at capturing financial liberalization and competition in the banking sector turn out to be the major determinants of credit growth in the CEE-5, while GDP per capita is the only variable that enters the estimated equations in a robust manner for the Baltic and Southeastern European countries. Furthermore, we find the estimated coefficients for transition economies are much higher than those obtained for OECD and emerging market economies, which testifies to the bias caused by the initial undershooting of private credit to GDP in most countries. Another interesting result is that house prices are found to lead to an increase in private credit only in countries with high house price inflation. This finding disqualifies

the house price variable from being included in the long-run equation to be used for the derivation of the equilibrium level of private credit.

We have emphasized that relying on in-sample panel estimates of the equilibrium level of private credit for transition economies is problematic not only because of the possible bias which shows up in the estimated coefficients due to the initial undershooting, but also because the equations estimated for transition economies are not sufficiently stable. To overcome these problems, we used small open OECD countries as a benchmark to derive the equilibrium level of private credit for transition economies as our intention to use the emerging markets panel as the benchmark was thwarted by the lack of robustness of the empirical results. Another reason for using the small OECD panel as a benchmark is the following. Transition economies are expected to converge in behavior to this panel in the longer run. Hence, such a panel provides us with coefficient estimates that can be used to infer equilibrium credit-to-GDP ratios which apply in the long run for transition economies.

We can draw some general conclusions with regard to undershooting and overshooting for transition economies, even though the application of the out-of-sample small open OECD panel to transition economies yields a wide corridor of deviations from the equilibrium. Considering the midpoint of the estimated interval, Croatia is the only country which might have reached the equilibrium by 2004. When looking at whole ranges, the upper edges of the estimated band reached equilibrium in Bulgaria, Estonia, Hungary, Latvia and Slovenia, although the mass of the estimated deviation was still located mostly on the undershooting side in 2004. Moreover, it turns out that the initial overshooting might not have been that large for the Czech Republic and Slovakia, after all. Finally, it is interesting to see that the initial undershooting remains relatively stable for Lithuania, Poland and Romania throughout the period. Overall, our results suggest that the CEE countries cannot be generally regarded as (over)shooting stars in terms of their credit-to-GDP ratios despite robust credit growth observed in most of the countries. However, Croatia seems to outcompete the other countries in the pursuit of the title of an (over)shooting star, albeit Bulgaria, Estonia,

Hungary, Latvia and Slovenia are still trying hard to fight back.

The prospects for the future are that credit growth will very likely remain rapid in CEE or to accelerate further in those countries where it is still comparatively moderate, given that the underlying factors which support private sector credit dynamics will remain at work for some time to come. As experience shows, the rapid pace of credit expansion and its persistence in a number of countries does by itself pose the risk of a deterioration of asset quality. Moreover, it exposes lenders and borrowers to risks because of an increase in unhedged foreign currency lending. Furthermore, the rapid adjustment process toward equilibrium levels may trigger demand booms, causing current account deficits to move above levels that can be sustained over a longer period of time. However, we leave it to future research to determine empirically the optimal speed of adjustment toward equilibrium that does not jeopardize macroeconomic and financial stability.

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8 Appendix

8.1 Data Appendix

8.1.1 Data Sources and Definitions

Quarterly data for bank credit to the private sector, credit to the government sector, short-term and long-term interest rate series, the consumer and producer price indices (CPI and PPI), real and nominal GDP, and industrial production are obtained from the International Financial Statistics of the IMF accessed via the database of the Austrian Institute for Economic Research (WIFO).[26] For some emerging markets, industrial production data is not available from this source, and hence are obtained from national data sources. Inflation is computed as a year-on-year rate ($p_t - p_{t-4}$). Lending rates are based on bank lending rates, and wherever not available, long-term government bond yields are used instead. Three-month treasury bill rates, and wherever not available, money market rates, are employed for short-term interest rates. The spread is calculated using lending (or, wherever not available, long-term government bond yields) and deposit rates.

GDP per capita expressed in PPS against the euro and the U.S. dollar is drawn from the AMECO database of the European Commission and the World Economic Indicators of the World Bank, respectively. The data start in 1975 for OECD countries and the emerging markets and in the 1990s for transition economies. The data are linearly interpolated from annual to quarterly frequencies. The financial liberalization index (from 0 to 20) reported in Abiad and Mody (2003) and used in Cottarelli et al. (2005) is used for OECD and emerging market economies. The data cover the period from 1975 to 1996 and are available for all emerging countries and for nine OECD economies, namely the large OECD countries plus Canada, Australia and New Zealand. For the transition economies, the average of the liberalization index of the banking sector and that of the financial sector provided by the EBRD from 1990 to 2004 are used (rescaled from the range 1 to

[26] IFS codes: Bank credit to the private sector: lines 22d and 22g; credit to the government: lines 22a, 22b and 22c; interest rates: lines 60b, 60c, 60l, 60p and 61; CPI and PPI: lines 64 and 63; nominal GDP: lines 99b and 99b.c; real GDP: lines 99bvp and 99bvr; industrial production in industry: lines 66, 66..c and 66ey (in manufacturing).

4+ to the range 0 to 20, which corresponds to the scaling used in Abiad and Mody, 2003). The data are linearly interpolated from annual to quarterly frequencies. Data for the existence of public and private credit registries are taken from Djankov et al. (2005), who provide data for 1999 and 2003. The series we use can take three values: 0 in the absence of both public and private registries; 1 if either public or private credit registries are in operation and 2 if both exist. This variable basically captures whether a change between 1999 and 2003 alters the supply of credit during this period. GDP per capita, the financial liberalization index and the registry variable are transformed to a quarterly frequency by means of linear interpolation.

House prices are not available for emerging countries and for Italy. For transition economies, data could be obtained only for the Czech Republic, Estonia, Hungary and Lithuania. Quarterly data for the OECD economies are obtained from the Macroeconomic Database of the Bank for International Settlements (BIS) and Datastream. The source of the data is the respective central banks for the Czech Republic, France, Hungary and Lithuania and the national statistical office for Estonia.

8.1.2 The Span of the Data

Starting dates (the series end in 2004:q4 if not indicated otherwise)

Private credit (the same applies to **public credit** if not indicated otherwise in parentheses):

OECD: 1975:q1- 2004:q4;

Emerging markets: 1975:q1- 2004:q4 except for ARG: 1982:q3 (1983:q3); BR: 1988:q3 (1989:q3); INDO: 1980:q3; PE: 1984:q1 (1985:q1); TK: 1990:q1 (1987:q4)

Transition economies: HU, PL: 1990:Q4; BG, EE, SI: 1991:q4; LT: 1993:q1; LV: 1993:q3; CZ, SK: 1993:q4; HR: 1993:q4 (1994:q2); EE: 1991; RO: 1996:q4.

Spread (in parentheses for **spread2** if different):

OECD: 1975:q1 except for DE: 1977:q3; NO: 1979:q1; IE:1979:q3; FI, NE: 1981:q1; NZ: 1981:q4; ES: 1982:q1; IT: 1982:q3

Emerging markets: INDO, KO, PH: 1975:q1; CH, TH: 1977:q1; SA: 1977:q4; IND, ME: 1978:q1; IS: 1983:q1; PE: 1988:q1; ARG: 1993:q2; BR: 1997:q1; TK: not available

Transition economies: HU, PL: 1990:q1; BG: 1991:q1; SI: 1991:q4; HR: 1992:q1; CZ, LT, SK: 1993:q1; EE: 1993:q2; LV: 1993:q3; RO: 1995:q4.

PPI (**CPI, industrial production** (IP), if different):

OECD: 1975:q1 except for PPI in NO, NZ: 1977:q1; BE: 1980:q1; IT: 1981:q1

Emerging markets: 1975:q1 except for ARG: 1987:q1 (1994:q1; NA); BR: 1992:q1 (1992:q1, 1991:q1); CH: 1976:q1 (1976:q1, 1975:q1); INDO: IP:1976:q1; IS: IP not available; KO: IP: 1980:q1; PE: 1980:q1 (1980:q1, 1979:q1); PH: 1993:q1 (1975:q1, 1981:q1); TK: 1987:q1 (1987:q1, 1980:q1)

Transition economies: BG: 1991:q1; CZ: 1993:q1; HR: 1993:q1; EE: 1993:q1 (1992:q1, 1993:q1); HU: 1990:q1; LV: 1994: q1 (1992:q1,1993:q1); LT: 1993:q1; PL: 1991:q1; RO: 1992:q1; SK: 1991:q1 (1993:q1, 1990:q1); SI: 1992:q1.

Real GDP:

OECD: 1975:q1 except for BE: 1980:q1; DK, PT: 1977:q1 and NZ: 1982: q2

Emerging markets: IND, IS, KO: 1975:q1; CH, ME: 1980:q1; PE: 1979:q1; PH: 1981:q1; TK: 1987:q1; BR: 1990:q1; ARG, INDO, TH: 1993:q1

Transition economies: SI: 1992:q1; HR, EE, LV, LT, RO, SK: 1993:q1; CZ: 1994:q1, HU, PL: 1995:q1; Data for India and Romania are linearly interpolated from annual to quarterly frequency.

All series stop in 2004:q4.

GDP per capita in PPS:

Data based on the euro for transition economies: CZ, PL, RO: 1990; BG, HU, SI: 1991; LV, LT: 1992; EE, SK: 1993; HR: 1995

Data based on the USD for transition economies: HR, HU, PL, RO: 1990; BG, EE, LV, LT, SK, SI: 1991; CZ: 1992.

Housing prices:

OECD: The starting date of the series is as follows: DK, DE, NE, SUI, UK, US: 1975:q1; JP: 1977:q1; SA: 1980:q1; FR: 1980:q4; CA: 1981:q1; FI: 1983:q1; SE: 1986:q1; AUS: 1986:q2; ES: 1987:q1, AT: 1987:q2; PT: 1988:q1; NZ: 1989:q4; IE: 1990:q1; BE, NO: 1991:q4; GR: 1994:q1. The series stop in 2004:q4.

Transition economies: CZ: 1999:q1-2004:q4; EE: 1994:q2-2004:q4; HU: 1991:q1-2004:q4; LT: 2000:q1-2004:q4

8.1.3 Estimation Results

Table A3. Estimation Results – Eq2 to Eq3

	ip	C^G	$i^{lending}$	p^{PPI}	$spread$	$gdpr$	C^G	$i^{lending}$	p^{PPI}	$spread$
Large OECD										
FE_OLS	0.655***	-0.206***	-0.031	-1.643***	0.013	0.557***	-0.202***	-0.055*	-1.296***	-0.026
DOLS	0.925***	0.018	0.143***	-0.635***	0.120***	0.700***	0.023	0.184***	-0.897***	0.158***
MGE	0.390	0.130	0.056	-3.480***	0.364**	0.067	0.119	-0.022	-2.406**	0.316*
Small OECD										
FE_OLS	0.767***	-0.115***	-0.089***	-0.888***	-0.134***	1.163***	-0.099***	0.029*	-0.334***	-0.108***
DOLS	1.113***	-0.011	0.029**	0.024	0.038**	1.272***	0.036**	0.038***	0.306***	-0.119
MGE	2.533***	0.254*	0.024	-2.903*	0.945**	2.111***	0.018	0.101	-1.169	0.458
Emerging market economies										
FE_OLS	0.483***	-0.097***	0.078***	-0.416***	-0.003	0.419***	-0.119***	0.097***	-0.150**	0.019
DOLS	0.589***	-0.006***	0.077***	-0.503***	-0.201***	0.729***	-0.030***	0.133***	-0.212*	-0.148***
MGE	0.502***	-0.253***	0.867	-0.333***	-0.555	0.109***	-0.089***	0.885**	-0.908**	-0.986
CEE-5										
FE_OLS	-0.105	-0.293***	-0.181***	-1.202***	-0.379***	0.639***	-0.282***	-0.086	-1.018***	-0.472***
DOLS	0.158	-0.347***	-0.050	0.848***	-0.121**	0.980***	-0.109	0.089	1.012***	-0.198***
MGE	-1.088*	-0.467***	-0.830**	1.030	-1.157	0.830	0.065	-0.067***	0.056	-0.587*
B-3										
FE_OLS	1.589***	-0.004	-0.290***	0.621*	-0.463***	2.771***	0.006	0.128	0.411	-0.376***
DOLS	1.905***	-0.087	0.371***	-3.927***	0.709***	3.169***	-0.076	0.423***	-1.885***	-0.184
MGE	1.198	2.772**	-2.259	-3.632***	0.827	12.374**	1.258*	-0.757	-4.716***	-1.985
SEE										
FE_OLS	0.908***	0.096	-0.729	0.166	-1.349***	3.464***	0.129	0.308**	-1.920***	0.159
DOLS	0.973***	0.110	-0.682	0.140	-1.247***	3.464***	0.129	0.308**	-1.920***	0.159
MGE	2.174**	-0.197	0.091	-1.799	0.722	4.023***	-0.145	0.431	-2.743**	0.231

Notes: *,** and *** indicate statistical significance at the 10%, 5% and 1% significance levels, respectively. See also Table 4.

Table A4. Estimation Results – Eq4 to Eq5

	$capita$	C^G	$i^{short-term}$	p^{PPI}	$spread$	$capita$	C^G	$i^{lending}$	p^{CPI}	$spread$
Large OECD										
FE_OLS	0.426***	-0.202***	0.027	-0.520**	0.005	0.362***	-0.201***	0.037	-1.687***	-0.024
DOLS	0.412***	-0.002***	0.071***	0.122	0.206**	0.361***	-0.025***	0.177***	-0.681**	0.155***
MGE	0.007	0.147	0.097	-2.471**	0.288***	0.044	0.150	0.088	-2.788***	0.198**
Small OECD										
FE_OLS	0.501***	-0.177***	-0.054***	-0.173	-0.045***	0.544***	-0.157***	-0.110***	1.181***	-0.039***
DOLS	0.447***	-0.085***	-0.105***	0.741***	-0.112***	0.626***	-0.002***	-0.149***	1.645***	-0.165***
MGE	0.686***	0.045	-0.060	-0.103	0.222	0.756***	0.573*	-0.165	-1.196	-0.592
Emerging market economies										
FE_OLS	0.508***	-0.237***	0.004	0.115*	0.112***	0.485***	-0.082***	0.143***	-0.414***	0.065*
DOLS	0.621***	-0.049***	-0.089	0.319*	0.023	0.716***	-0.032***	0.041*	-0.327***	-0.018
MGE	0.426***	-0.521***	-0.360	-0.852	-1.352	0.813***	-0.034***	0.239	-1.171***	-0.176
CEE-5										
FE_OLS	0.102	-0.288***	-0.085**	-1.154***	-0.476***	0.210	-0.272***	0.005	-1.095***	-0.412***
DOLS	-0.280	-0.272***	0.040	0.211	-0.057	0.207**	-0.263***	-0.135	0.467**	-0.296***
MGE	0.019	-0.216**	-0.105***	-0.729	-0.619	-5.367*	-0.401***	-0.776***	-12.111	-3.641**
B-3										
FE_OLS	2.148***	0.021	0.217***	0.581**	-0.192**	2.611***	0.005	0.479***	-0.385*	-0.522***
DOLS	2.183***	-0.179	0.002	-1.625***	-0.337	2.018***	0.121	0.160***	-1.375***	-0.011
MGE	4.174	0.313	-0.759	-5.100**	-1.178*	-3.755	0.285	-0.344	-7.268	-0.905
SEE										
FE_OLS	0.678***	0.009	-0.354	-0.953**	-1.024***	1.217***	0.073	-0.024	0.099	-0.463***
DOLS	0.678***	0.009	-0.354	-0.953**	-1.024***	1.217***	0.073	-0.024	0.099	-0.463***
MGE	1.539***	0.284	0.058	-0.654**	-0.204	0.911**	0.548	-0.546	-0.112	0.245

Notes: See Table A3.

Table A5. Estimation Results – Equation 6 to Equation 7

	$capita$	C^G	$i^{long-term}$	p^{PPI}	$finlib$	$capita$	C^G	$i^{long-term}$	p^{PPI}	$spread$	reg
Large OECD											
FE_OLS	0.381***	-0.285***	0.015	0.022	0.111***	0.484***	-0.174***	-0.067***	-0.165	-0.036***	0.236***
DOLS	0.435***	0.012	0.122***	-0.660***	-0.304***	0.180***	-0.006	0.059***	-0.120	0.025	0.042
MGE	0.405	0.041	0.160	-0.583***	0.084	-0.237	0.144	-0.089	-1.365	0.088	-0.064
Small OECD											
FE_OLS	0.483***	-0.088***	-0.131***	0.192	0.223***	0.484***	-0.174***	-0.067***	-0.165	-0.036***	0.236***
DOLS	2.337***	-2.619*	2.274	2.076	4.722	0.059***	0.006	0.024***	0.006	0.008	0.011
MGE	1.077	-0.283	-0.463	-0.638	0.307***	0.038	0.074	0.005	-0.209	0.024	-0.015
Emerging market economies											
FE_OLS	0.269***	0.069***	-0.035**	0.137***	0.302***	--	--	--	--	--	--
DOLS	3.081***	-3.117***	2.640	-2.313***	5.679	--	--	--	--	--	--
MGE	1.084	-1.846	-0.152**	-0.379	0.141**	--	--	--	--	--	--
CEE-5											
FE_OLS	0.663***	-0.298***	-0.008	-1.412***	-0.985***	0.220*	-0.257***	-0.011	-1.096***	-0.208*	-0.119**
DOLS	0.906***	-0.408***	-0.121	0.698	-1.304***	0.253**	-0.068	0.222***	0.104	-0.069	-0.146***
MGE	-19.708	-1.645**	-8.252***	2.034	-4.405	0.139	0.015	0.232**	-0.183	0.001**	-0.170***
B-3											
FE_OLS	2.713***	-0.085*	0.485***	0.694**	-0.013	2.580***	0.012	0.412***	0.619**	-0.394***	0.157
DOLS	2.002***	0.123	0.135*	-1.924***	-0.041	0.439	0.254**	0.152***	-1.739**	0.017	-0.005***
MGE	2.828	0.353	-0.735***	-2.427	-0.312***	0.377	0.640*	0.500	-4.486	0.767	-0.565**
SEE											
FE_OLS	1.792***	0.053*	0.101	-0.221	-3.087***	1.919	0.182**	0.120***	0.334	-0.828***	-0.269***
DOLS	1.792***	0.053*	0.101	-0.221	-3.087***	1.919	0.182**	0.120***	0.334	-0.828***	-0.269***
MGE	2.523**	-0.432	1.600**	-1.588**	-0.160	4.965***	0.470***	1.015***	-0.907***	0.112	-0.577***

Notes: See Table A3.

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